Uniportal and three-portal video-assisted thoracic surgery lobectomy: analysis of the Italian video-assisted thoracic surgery group database

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Abstract

OBJECTIVES: This study compares the uniportal with the 3-portal video-assisted thoracic surgery (VATS) by examining the data collected in the Italian VATS Group Database. The primary end point was early postoperative pain; secondary end points were intraoperative and postoperative complications, surgical time, number of dissected lymph nodes and length of stay.

METHODS: This was an observational, retrospective, cohort, multicentre study on data collected by 49 Italian thoracic units. Inclusion criteria were clinical stage I–II non-small-cell lung cancer, uniportal or 3-portal VATS lobectomy and R0 resection. Exclusion criteria were cT3


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INTRODUCTION

First proposed more than 25 years ago, video-assisted thoracic surgery (VATS) lobectomy is a well-established approach for the treatment of early-stage non-small-cell lung cancer (NSCLC) that gained the ‘grade 2C’ recommendation as a preferred technique over open surgery by the American College of Chest Physicians evidence-based guidelines in 2013 [1, 2]. It is a current opinion that VATS lobectomy results in less pain, fewer complications and more rapid return to normal functioning when compared with open surgery; these assumptions are validated by trial meta-analyses, even though most of those trials were not randomized [3, 4]. To be precise, ‘VATS lobectomy’ is a term covering a series of surgical approaches that vary significantly in the number of incisions, in the width of utility incision and in the way of dealing with the pulmonary hilum; in addition, some imaginative techniques were described, such as the transcervical [5] or the subxiphoid uniportal approaches [6] and microlobectomy [7]. Nevertheless, the 3-portal anterior approach described by Hansen and Petersen [8] is the most popular technique; yet, if VATS lobectomy were superior to open thoracotomy due to minimal surgical access trauma, an additional reduction in such access trauma should lead to better outcomes. This consideration prompted Diego Gonzales Rivas to propose his uniportal VATS (u-VATS) lobectomy in 2010 [9]. Accepted with scepticism, the uniportal VATS group had higher operative time (P < 0.001), shorter chest drain permanence (P < 0.001) and shorter length of stay (P < 0.001).

CONCLUSIONS: Data from the Italian VATS Group Database showed that in clinical practice uniportal lobectomy seems to entail a higher risk of moderate/severe pain on second and third postoperative days.

Keywords: Video-assisted thoracic surgery • Lobectomy • Uniportal • Three-portal • Postoperative pain • Italian VATS Group

PATIENTS AND METHODS

This was an observational, retrospective, cohort, multicentre study on data collected by 49 Italian thoracic surgery units after approval from the Italian VATS Group Database Committee; this Committee verifies whether each centre has completed the learning curve. The database collects all the VATS lobectomies performed with specific technical requirements: all VATS techniques are included, with utility incision up to 6 cm, without rib spreading and a soft tissue divider is allowed. Surgeons operate exclusively through the video equipment; hilar structures must be individually dissected, a standard lymphadenectomy is required and the surgical specimen must be removed with an endobag, avoiding contact with the chest wall incision. Collected data are periodically audited to verify their correspondence to the original data source. Clinical and pathological staging were recorded using the American Joint Committee on Cancer seventh edition TNM classifications until 31 December 2017; a data conversion to the eighth edition is planned in the near future. Variable definitions within the data set are standardized and data entry consistency is ensured by the use of a dropdown menu.

The present study protocol was submitted to the Italian VATS Group Database Committee for approval; therefore, the data collection and study protocol were approved by the local ethics committee (n.723Bis) and the participating patients were requested to sign a written consent. A data set containing clinical records from patients who received VATS lobectomy from January 2014 to July 2017 was obtained; patients and centres data were anonymized.

Inclusion criteria were clinical stage I–II NSCLC, 3-portal or u-VATS lobectomy and R0 resection. Exclusion criteria were previous thoracic surgery, cT3 disease, previous thoracic malignancy, induction therapy, connective tissue disease, peripheral vascular disease, dementia and diabetes mellitus with organ damage and conversion to other techniques. The primary outcome was pain measured with the numeric rating scale (NRS); secondary outcomes were operating time, lymph node retrieval, the volume of blood loss, complication prevalence, chest drain duration, post-operative length of stay and 30-day mortality.

Three-portal VATS in the standardized anterior approach, described from the Copenhagen group, surgeon and assistant usually operate on the same side of the table, facing the patient. The first step is a 4- to 5-cm anterior incision, without rib spreading,
positioned between the breast and the lower angle of the scapula, usually in the fourth intercostal space, just anterior to the latissimus dorsi muscle. After thoracoscopic evaluation, a low anterior 1- to 1.5-cm camera port is positioned anteriorly to the hilum, at the level of the diaphragm. The third 1.5-cm incision is made further posteriorly in a straight line down from the scapula. Some surgeons use the same intercostal space for the 2 ports, to reduce traumatism to different spaces. The 30° angled camera is usually inserted in the lower port [8].

When performing uniportal VATS, the first operator stands in front of the patient, whereas the assistant can either stand in front of or alongside the surgeon, depending on one’s preference and from the type of lobectomy to be performed. A single incision up to 6 cm is made in the fourth to sixth intercostal space, between the mid and anterior axillary line, without retractors; some surgeons are used to a more anterior approach, where intercostal space is wider. The camera is usually held in the posterior part of the incision [9].

In the case of both techniques, lobectomy can be performed with a ‘hilum first’ or ‘fissure first’ approach, depending on the surgeons’ preference. In both cases, hilar structures are individually dissected, and a standard lymphadenectomy, as in open surgery, is mandatory.

Each enrolling centre independently has chosen intraoperative and postoperative analgesic strategies.

**Statistical analysis**

Continuous data are presented as the median and the interquartile range or the mean and the standard deviation. Categorical variables are shown as frequencies and percentages. The Wilcoxon signed-rank test or $\chi^2$ test was used as appropriate. Confidence intervals (CIs) were at 95% and 2-sided $P$-values were calculated. A $P$-value of <0.05 was considered statistically significant. NRS was measured on a postoperative day (POD) 1, POD2, POD3 and on discharge day. Before analysis, the intensity of pain was dichotomized: (NRS) $<3$ described mild pain; whereas NRS score $>3$ described moderate/severe pain [17, 18]. NRS repeated measure data were analysed using ‘mean response profile’ method through generalized estimating equations (GEE) by employing time as a categorical variable, logit link function for linear predictor, a sandwich estimator for standard errors and unstructured working correlation matrix, selected by correlation information criterion. Repeated measurement design of participants’ responses involves correlation within each participant. Correct inferences can only be obtained by taking into account this within-participant correlation between repeated measurements. GEE is the 1 statistical approach for analysing correlated data. Furthermore, GEE accounts also for the multicentre nature of the study.

We choose GEE because it allows a population-averaged interpretation of the regression coefficients [19]. The null hypothesis is that the difference of relative frequencies between the 2 surgical techniques is constant over time. This was tested using the multivariate Wald test, testing time (POD) × group interaction in the GEE regression model. Profile likelihood CIs were computed and univariate Wald test for each GEE-estimated parameter was used.

To reduce the impact of selection bias we used the propensity score (PS). The PS is defined as the conditional probability of assignment to a treatment, given a vector of particularly observed covariates; it is designed to mimic some of the particular characteristics of a randomized clinical trial within the context of an observational study. As appropriate and with caution, PS analysis allows an estimation of relative risk in binary outcomes [20]. We computed a PS for individual patients with logistic regression using demographic and clinical variables and evaluated the interaction among all preoperative covariates and square terms without time-dependent variables. The variables included into PS were all the preoperative patients’ characteristics reported in Table 1, including the conversion rate and epidural catheter, intercostal block, elastomeric pump and pericostal catheter. The generalized additive model was used to check the linear assumption on the logit scale in the PS model. Technically, PS becomes an additive covariate into the linear predictor of the GEE regression model, using natural cubic splines.

We established a 1.5 clinical effect-size threshold for the odds ratio (OR), a value that is compatible with clinical experience and published indices. We also performed additionally 1:1 PS matching analysis using the nearest neighbour algorithm without replacing with a caliper of 0.2. All analyses were carried out using the R software package version 3.2.2.

**RESULTS**

Forty-nine Italian thoracic surgery units were actively enrolling their patients in the Italian VATS Group Database at data extraction date. Among 4338 patients enrolled from January 2014 to July 2017, 1980 met the inclusion criteria, whereas 2358 were excluded from the analysis. Three hundred and twenty-three patients were excluded due to conversion to other techniques; the conversion rate in the 3-portal and in the uniportal approach were 9.9% and 8.0%, respectively. Finally, 1808 patients underwent 3-portal lobectomy and were included in the 3-portal VATS group, 172 received uniportal surgery and were included in the u-VATS group.

Table 1 reports demographic and clinical characteristics of the study sample. The 2 groups were homogenous except for age, Charlson index, positron emission tomography standard uptake value of the lung nodule, type of lobectomy and postoperative pain relief devices (Fig. 1).

The unadjusted GEE regression model showed that pain decreased over time in the 2 groups ($P < 0.001$). There was a statistical difference in pain over time between the 2 groups ($P < 0.001$). In particular, there was no difference on POD1 (OR 1.26, 95% CI 0.90–1.74; $P = 0.170$) and on discharge day (OR 0.64, 95% CI 0.27–1.49; $P = 0.310$), whereas there was a difference on POD2 and POD3, in favour of 3-portal VATS. The u-VATS group had a higher risk of pain (NRS > 3) on second and third PODs (OR 2.47, 95% CI 1.76–3.45; $P < 0.001$; OR 2.80, 95% CI 1.89–4.16; $P < 0.001$, respectively) (Table 2).

The adjusted GEE regression model using PS showed closer results; pain decreased over time in the 2 groups ($P < 0.001$). There was a statistical difference in pain over time between the 2 groups ($P < 0.001$). There were no differences on POD1 (OR 1.16, 95% CI 0.83–1.62; $P = 0.401$) and on discharge day (OR 0.59, 95% CI 0.26–1.37; $P = 0.219$). On the second and third PODs, differences in favour of 3-portal VATS were still evident: OR 2.28, 95% CI 1.62–3.21; $P < 0.001$; OR 2.58, 95% CI 1.74–3.83; $P < 0.001$, respectively. NRS categorized values over time are reported graphically in Fig. 1. The PS matching based on 172 patients from each group yielded similar results with slightly wider CI, compared to PS adjusted regression analysis (POD1: OR 1.18, 95% CI 0.74–
A considerable number of case series on uniportal VATS is available in the scientific literature; essentially, these papers support the fact that uniportal VATS lobectomy is possible and reasonably safe [21–24]. On the contrary, contrasting results are reported by studies comparing the 3-portal versus the uniporal approach to VATS lobectomy. To the present date, there is only a single monocentric randomized study comparing the uniportal with the ‘multiports’ VATS lobectomy; such a trial did not reveal statistically significant differences in terms of postoperative pain and median morphine use between the 2 groups [25]. The trial has been properly conducted but, unfortunately, the sample size was rather under-dimensioned, mainly because ‘multiports’ group (55 patients) included 2 different procedures: the Duke 2-port technique and the Copenhagen 3-portal approach. Considering that the number of ports could potentially affect pain perception, increasing the sample size would have proved correct.

A recent systematic review and meta-analysis, which included the original uniportal proponent among the authors, collected 8 papers published between 2014 and 2016 [26]. The 8 studies, all from Asian centres, analysed retrospectively uniportal versus ‘multiportal’ VATS lobectomy; 78 was the average number of patients enrolled in uniportal arms and 153 in ‘multiportal’ arms. ‘Multiportal’ VATS lobectomy included a 3-ports procedure (4 papers), 2 and 3 ports procedures (2 papers), 3- and 4-ports procedure (1 paper) and an unknown number of ports (1 paper). The authors found no significant differences between uniportal versus ‘multiportal’ VATS in operative time, perioperative blood loss and rate of conversion to open surgery; patients who underwent a uniportal approach showed a statistically significant reduction in the duration of postoperative drainage, in length of hospital stay and in morbidity. It was disappointing to observe that such advantages in choosing the uniportal approach disappeared after a propensity match analysis. Recently, an observational study by Louis comparing multiport to uniportal VATS, has been conducted but, unfortunately, the sample size was rather under-dimensioned, mainly because ‘multiports’ group (55 patients) included 2 different procedures: the Duke 2-port technique and the Copenhagen 3-portal approach. Considering that the number of ports could potentially affect pain perception, increasing the sample size would have proved correct.

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1.83; P = 0.494; POD2: OR 2.36, 95% CI 1.38–3.92; P < 0.001; POD3 OR 2.26, 95% CI 1.29–3.98; P = 0.01; discharge day: OR 0.63, 95% CI 0.23–1.89; P = 0.043). The absolute standardized mean differences between baseline covariates after matching, ranges from 0.012 to 0.13, indicating sufficient covariate balance.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Uniportal group (n = 172)</th>
<th>Three-portal group (n = 1808)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (male), n (%)</td>
<td>89 (59.7)</td>
<td>989 (54.7)</td>
<td>0.507</td>
</tr>
<tr>
<td>Age (years), median (IQR)</td>
<td>69.5 (11.3)</td>
<td>68.0 (12.0)</td>
<td>0.002</td>
</tr>
<tr>
<td>Charlson index, median (IQR)</td>
<td>4 (3)</td>
<td>4 (2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>FEV1, median (IQR)</td>
<td>92.0 (25.9)</td>
<td>96.0 (27)</td>
<td>0.161</td>
</tr>
<tr>
<td>Tiffeneau, median (IQR)</td>
<td>75.6 (15.5)</td>
<td>76.7 (13.0)</td>
<td>0.081</td>
</tr>
<tr>
<td>COPD, n (%)</td>
<td>20 (11.6)</td>
<td>310 (17.1)</td>
<td>0.080</td>
</tr>
<tr>
<td>Diabetes, n (%)</td>
<td>27 (13.0)</td>
<td>203 (11.2)</td>
<td>0.623</td>
</tr>
<tr>
<td>Coronary disease, n (%)</td>
<td>14 (8.1)</td>
<td>159 (9.0)</td>
<td>0.881</td>
</tr>
<tr>
<td>ECOG score, median (IQR)</td>
<td>0 (1)</td>
<td>0 (0)</td>
<td>0.111</td>
</tr>
<tr>
<td>CT scan T dimension (cm), n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;2</td>
<td>87 (50.6)</td>
<td>951 (52.4)</td>
<td>0.669</td>
</tr>
<tr>
<td>2–3</td>
<td>53 (30.8)</td>
<td>521 (28.7)</td>
<td>0.643</td>
</tr>
<tr>
<td>3–5</td>
<td>31 (18.0)</td>
<td>298 (16.4)</td>
<td>0.681</td>
</tr>
<tr>
<td>5–7</td>
<td>1 (0.6)</td>
<td>37 (2.0)</td>
<td>0.295</td>
</tr>
<tr>
<td>&gt;7</td>
<td>0 (0.0)</td>
<td>1 (0.05)</td>
<td>0.999</td>
</tr>
<tr>
<td>Clinical nodal involvement, n (%)</td>
<td>14 (8.1)</td>
<td>86 (4.8)</td>
<td>0.079</td>
</tr>
<tr>
<td>PET scan SUV, median (IQR)</td>
<td>4 (5)</td>
<td>3 (7)</td>
<td>0.024</td>
</tr>
<tr>
<td>Right side, n (%)</td>
<td>110 (64.0)</td>
<td>1123 (62.1)</td>
<td>0.694</td>
</tr>
<tr>
<td>Lobectomy types, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right upper lobectomy</td>
<td>60 (34.8)</td>
<td>632 (34.9)</td>
<td>0.999</td>
</tr>
<tr>
<td>Right middle lobectomy</td>
<td>8 (4.7)</td>
<td>157 (8.7)</td>
<td>0.092</td>
</tr>
<tr>
<td>Right lower lobe</td>
<td>37 (21.4)</td>
<td>318 (17.6)</td>
<td>0.238</td>
</tr>
<tr>
<td>Upper bilobectomy</td>
<td>5 (3.0)</td>
<td>9 (0.5)</td>
<td>0.001</td>
</tr>
<tr>
<td>Lower bilobectomy</td>
<td>0 (0)</td>
<td>7 (0.4)</td>
<td>0.885</td>
</tr>
<tr>
<td>Left upper lobectomy</td>
<td>29 (16.9)</td>
<td>378 (20.9)</td>
<td>0.248</td>
</tr>
<tr>
<td>Left lower lobectomy</td>
<td>33 (19.2)</td>
<td>307 (17.0)</td>
<td>0.531</td>
</tr>
<tr>
<td>Adenocarcinoma, n (%)</td>
<td>128 (74.5)</td>
<td>1330 (73.6)</td>
<td>0.878</td>
</tr>
<tr>
<td>Squamouscellar carcinoma, n (%)</td>
<td>19 (11.0)</td>
<td>228 (12.6)</td>
<td>0.637</td>
</tr>
<tr>
<td>Other histology, n (%)</td>
<td>25 (14.5)</td>
<td>250 (13.8)</td>
<td>0.888</td>
</tr>
<tr>
<td>Epidermal catheter, n (%)</td>
<td>11 (6.4)</td>
<td>475 (26.3)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Intercostal block, n (%)</td>
<td>148 (86)</td>
<td>932 (51.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Elastomeric pump, n (%)</td>
<td>34 (19.8)</td>
<td>684 (37.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pericostal catheter, n (%)</td>
<td>0 (0.0)</td>
<td>104 (5.7)</td>
<td>0.002</td>
</tr>
</tbody>
</table>

CT: computed tomography; COPD: chronic obstructive pulmonary disease; ECOG: eastern cooperative oncology group; FEV1: forced expiratory volume in 1 second; IQR: interquartile range; PET: positron emission tomography; SUV: standardized uptake value.
reported a significant decrease in postoperative narcotic consumption in the unportal group [27]. This is the first study that demonstrates lower analgesic consumption in a Western country; nevertheless, researchers at University of Kansas Hospital analysed their retrospective cohort in a peculiar way; in other words, patients who underwent a procedure with the unportal technique and required additional ports were included in the ‘multiportal’ group.

Despite its weak scientific validation, unportal VATS lobectomy constitutes an exciting technical development in thoracic surgery and exerts an extraordinary magnetism on young surgeons. The unportal approach is having a large diffusion, even though its penetration in Western countries is still limited. The peculiar characteristics of the unportal approach prompted the authors to compare this technique to the more widespread 3-portal VATS lobectomy in Italy. The 2-portal approach and other less common techniques were excluded from the data collection to minimize a potential bias; for the same reason, we limited the analysis to patients free from comorbidities, such as connective tissue disease or severe diabetes. In addition, we limited the data extraction to patients with no potentially critical local situation, such as previous thoracic surgery or cancer infiltrating the thoracic wall. Patients converted to other techniques were also excluded from the analysis. Finally, we obtained from the Italian VATS Group database a data set consisting of 1980 patients who underwent VATS lobectomy for clinical stage I–II NSCLC; these patients presumably constitute a population with reasonably homogeneous characteristics.

Our adjusted for PS and not adjusted analyses showed that the intensity of pain reported by patients decreased over time; at discharge, only ~3% of them had moderate or severe pain. The trend of pain was different in the 2 groups; namely, the probability to have moderate or severe pain in POD2 and POD3 was double for patients who underwent unportal lobectomy versus patients who had 3-portal lobectomy (POD2: OR = 2.28; POD3: OR = 2.58). We are aware that our results diverge from current literature; however, this is the largest observational study focussed on unportal versus 3-portal VATS lobectomy, and its national scope allows a better insight into actual clinical practice. A simple explanation of major pain in the unportal approach could be the crowding of the scope and instruments in a single incision; despite experienced surgeons could limit this problem, such congestion probably leads to heavier pressure on the thoracic wall than in manoeuvres performed through 3 ports.

In our study, the unportal approach appears technically more demanding than the 3-portal technique, considering the longer operative time; notwithstanding, the number of dissected lymph nodes and the volume of intraoperative blood loss were similar. These last results support the idea that the procedure is feasible and safe. Complication prevalence was similar, and no mortality was observed in both groups. The postoperative length of stay

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**Table 2:** Mean postoperative NRS

<table>
<thead>
<tr>
<th>Group</th>
<th>POD1</th>
<th>POD2</th>
<th>POD3</th>
<th>Discharge day</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-VATS, mean NRS (SD)</td>
<td>3.2 (1.9)</td>
<td>3.3 (2.1)</td>
<td>2.4 (1.8)</td>
<td>1.4 (1.1)</td>
</tr>
<tr>
<td>Three-port VATS, mean NRS (SD)</td>
<td>3.1 (1.5)</td>
<td>2.5 (1.3)</td>
<td>2.0 (1.1)</td>
<td>1.6 (1.2)</td>
</tr>
</tbody>
</table>

NRS: numeric rating scale; POD: postoperative day; SD: standard deviation; U-VATS: uniportal video-assisted thoracic surgery.

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**Figure 1:** Percentage of patients with moderate/severe pain. u-VATS: uniportal video-assisted thoracic surgery; VATS: video-assisted thoracic surgery.
within the groups. In the current study, pain relieving techniques
were highly unbalanced in the 2 groups and we had to rely on
the adjusted statistical models.

CONCLUSION

In conclusion, the investigation of the Italian VATS Group data-
base, which collected 4338 procedures in 43 months, allowed the
selection of 1980 VATS lobectomy performed with the 3-portal
or uniportal approach. In this selected cohort, offering an insight
into the current clinical practice in Italy, patients who underwent
uniportal VATS lobectomy seem to present a double risk of mod-
erate to severe pain on the second and third PODs. In our opin-
ion, the uncritical adoption of the uniportal technique does not
guarantee a pain reduction in the immediate postoperative
course; therefore, a comprehensive vision of the analgesic treat-
ment is fundamental.

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APPENDIX. CONFERECE DISCUSSION
Dr R. Petersen (Copenhagen, Denmark): VATS lobectomy has become the standard of care for the majority of thoracic surgical departments in Europe during the last decade. Since the initial report of uniportal VATS lobectomy in 2010, the approach has attracted a lot of attention. Today more than 200 studies are published on uniportal VATS lobectomy and the majority of these studies are case reports, editorials and ‘how to do it’ papers. Only very few comparative studies have been published and among them only 1 randomized study from Spain. Feasibility has definitely been demonstrated even with very advanced cases, such as double sleeve resections, but the evidence of superiority of the uniportal approach compared to a multiporal approach is missing. I think we must congratulate the Italian team for their effort to provide comparative data.

I have 3 questions: Is it fair to conclude that there is less pain in the uniportal group, when the pain management regimen was so different? About 26% of patients having a 3-port approach had pain control using epidural analgesia and only 6% in the uniportal group. I know you tried to correct this with propensity score match, but I would like you to further elaborate on the differences.

Dr D. Tosi (Milan, Italy): We analysed both with the unmatched and matched results. The observation is correct because the analgesic devices can influence the results. The observation is correct because the analgesic devices can influence the results. The observation is correct because the analgesic devices can influence the results.

Dr R. Petersen: My second question is regarding the lengths of stay. It’s shorter in the uniportal group, 3 vs 4 days and it’s mainly explained by the shorter duration of chest drains in the uniportal group, which is 2 vs 3 days. But 22% of the patients in the 3-port groups had 2 chest drains versus only 0.6% in the uniportal group. Can you explain the reason for the different protocols among these centres?
Dr Tosi: I think that in a lot of centres the experience came from the open surgery and in the open surgery usually 2 drains are more common than 1. In the 2-portal group, the possibility of using 2 chest drains, maybe in some difficult cases, when you got a leakage at the end of the operation brings to this behaviour, whereas in the uniportal group, by definition 2 chest drains in 1 incision may be too much. It can be explained by the attitude of the particular centres so, if you perform uniportal VATS, you’ve got just 1 chest drain and you are in a hurry to discharge the patient early. In Italy you usually remove 1 chest drain and the other one on the following day: the next day you request a chest X-ray. I think this explains the difference in the length of stay.

Dr Petersen: The conversion rate in the 3-portal VATS group was only 0.1% in 1808 patients from 49 units and there was no 30-day mortality reported.

Dr Tosi: Regarding the complications, I think that complications after VATS procedures are recorded in the database and I’ve talked to the statistician of the VATS group database: the mortality really seemed to be zero. Regarding the converted procedures, those are one of the major limitations of our study because the database is voluntary. Of course, you’ve got the possibility to register the procedure as being converted, but in some cases converted procedures may not have been uploaded to the database.

Dr E. Pompeo (Rome, Italy): I think that despite the several biases, which can be found in the retrospective study like this, there are important issues to be noted. Firstly, in the uniportal approach postoperative pain was higher, following propensity score matching 2 or 3 days, postoperatively. This is important in my opinion because it introduced some ergonomic and methodological issues in this kind of approaches. First of all, the crowding of instruments through uniportal approaches is greater than through 3-port approaches, and this may also affect the postoperative pain and should be investigated in more detail. Secondly, the position of the tube is different, because through the uniportal approach you have to push the tube, making a curve inside the chest to allow draining all the chest areas and this, in my opinion, can also increase the postoperative pain. The problem does exist and this paper raised the question to be investigated more in detail.

Dr Tosi: It’s a correct observation. What I want to highlight is that this study’s aim is not to prove the superiority of 1 technique over the other. We have some biases, we know. This is really just a snapshot of the Italian clinical scenario. One of the hypotheses is that the crowding of the instruments in 1 incision can be more painful than 3 instruments in 3 trocars. Of course, we also have to think about the learning curve, because as you have seen, the operating time is longer in the uniportal group. Maybe in the next year, the difference between the techniques won’t be this big.

Dr H. V. Kara (Istanbul, Turkey): The number of lymph nodes excised is a good result. Would you comment on the preoperative mediastinal surgical staging for the groups that contribute patients to this study? Were all the patients evaluated with either mediastinoscopy or VAMLA before surgery? We all know that the number of the lymph nodes is effective according to the preoperative mediastinal staging. Did all those patients have preoperative mediastinal surgical staging, mediastinoscopy or VAMLA?

Dr Tosi: The number of lymph nodes is one of the most interesting results because both techniques had a similar number and with an adequate number of 15 lymph nodes each. The majority of patients did not undergo the mediastinoscopy before. We excluded the T3 disease, and those after induction therapy, so we included only stages I and II patients, therefore, very few underwent mediastinoscopy before.

Dr Kara: We all know that chest drain occupying the intercostal space is a major problem with pain. Regarding that 3-portal cases have 2 chest tubes, do you think it may cause a bias on the side of uniportal? The patient with 2 chest drains postoperatively will certainly have more pain than one with a single drain on the uniportal side. Can we conclude that uniportal is effective on the postoperative pain? Most of the patients on the 3-portal side have 2 drains, and when you pull out the drain, the pain dramatically decreases.

Dr Tosi: That’s correct, you have more pain because of the 2 drains. You can have more pain because the only drain is in the incision, so this is understandable. The results didn’t go in that direction so even patients with 2 chest drains had a lower level of pain.

Dr Kara: We can recommend you to make a subgroup analysis, regarding only the patients with a single chest tube.

Dr K. Naunheim (St. Louis, USA): I have to agree with Dr Gossot. One-port, 2-port, 3 port, 3 port, 4 port. It’s becoming less and less pertinent and less important. Certainly, in the USA, I know now in Europe, these Enhanced Recovery After Thoracic Surgery programmes, which use multiple intercostal blocks, with long-acting liposomal anaesthetics, anti-inflammatory drugs, etc. The question of postoperative pain is becoming moot. Essentially nobody is using epidural catheters anymore. This is a retrospective study, I think, in 2 senses. First of all, it’s retrospective in that you’re looking back at the database but it’s also looking at an old issue and one that is going to become less and less pertinent. I think that the real prospective issue we ought to be looking at in the future has to do with minimally invasive surgery versus SBRT, Stereotactic Body Radiotherapy. With the increasing utilization of lung cancer screening, we’re finding smaller and smaller lesions and at least in the USA, those patients are getting surgery less and less often. Not only because of the primary care physicians, but also because patients are choosing nonsurgical methodologies. They do not want surgery; they want less and less invasive procedures. I think that as a society of thoracic surgeons, AATS, ESTS and all of us in the future need to be focussing our attention not on these issues, which though pertinent, are old and really will not affect our specialty or our patients in the future. We need to be concentrating on this issue of surgery versus non-surgical treatment with SBRT. I think that’s the place where we need to put most of our emphasis because that’s where we’re going to make a difference and really help our patient population.